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### TITLE

ABSORBENT ARTICLE

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### FIELD OF THE INVENTION

The invention provides an absorbent article having a multi-tone signal of at least one color. The effect of the multi-tone signal creates a perception of depth by a user viewing the topsheet surface of the absorbent article.

### BACKGROUND OF THE INVENTION

Printing on or below the top surface of an absorbent article is known in the art. Printing to create a signal that masks stains is also known. Overcoming the problem of unsightly stain during, for example, a woman's menstrual period has been disclosed. What has not been disclosed or taught is the use of multi-toned printing to create a signal that provides a perception of depth to an absorbent article when the article is viewed from its top or viewing surface. By creating a perception of depth within the absorbent article a

user is reassured prior to use and during use that fluid will be drawn deep inside the product and away from a user's body.

Through the use of innovative topsheet materials, secondary topsheet materials, absorbent gelling materials and breathable backsheets, the technology in absorbent articles, and particularly sanitary napkins, has drastically advanced to provide women with more than adequate, if not excellent, products that absorb menses and other fluids away from a woman's body. However, much of this technology is often hidden and therefore not viewable. When seen, absorbent components often do not readily or visually communicate to a user the existence of this enhanced technology.

The ability to communicate to a consumer the existence of enhanced functioning of an absorbent article is a premium asset to any absorbent article. Hence, the use of the multi-toned signals has been created to begin to address the problem of such communication. This is especially so since mostly all of the products on the market today have as their main function the objective to mask menses rather than conveying the product's enhanced functioning power. The art is replete with examples of the use of a one-tone signal for such masking.

Communicating enhanced functioning characteristics by creating the perception of depth within an absorbent article is one unique and novel way to solve this problem, that prior to this reduction to practice has not been taught, suggested or disclosed by the prior art. Using multiple tones (i.e., at least two) of a color and/or multiple tones and multiple colors together to create a perception of depth can engender in a user the perceived belief of better protection and enhanced functioning by creating the perception of depth once a user has viewed the multi-tone configuration from the viewing surface of the absorbent article, such perception continuing through and after wear of the absorbent article.

#### SUMMARY OF THE INVENTION

Accordingly, the invention provides an absorbent article having an upper surface, a lower surface and a periphery comprising a topsheet having a bottom surface and a viewing surface positioned opposite to the bottom surface. The viewing surface faces

upwardly towards the upper surface of the absorbent article. The absorbent article further comprises a backsheet having a garment facing surface and a user facing surface positioned oppositely to the garment facing surface, the backsheet being joined to the topsheet.

- 5 An absorbent core having a top surface and a bottom surface that is positioned opposite to the top surface. The absorbent core is positioned between the topsheet and the backsheet. The viewing surface of the absorbent article preferably, but not necessarily, has at least two portions, i.e., a colored portion and a non-colored portion. The colored portion and the non-colored portion are viewable from the viewing surface of the
- 10 topsheet. The colored portion has at least two shades, a first shade and a second shade. The first shade is positioned substantially within the second shade. The second shade is different, either in lightness, darkness, and/or color, from the first shade. The multi-shades operate to create a perception of depth within the absorbent article by a user looking upon the viewing surface of the topsheet. In one embodiment herein, the first
- 15 shade of the color is darker than the second shade of the color. Alternatively, the first shade is lighter than the second shade.

- The color of the first shade and the second shade of the colored portion and the non-colored portion are measured by reflectance spectrophotometer ASTM standard test methodology. Tristimulus  $L^*$ ,  $a^*$ ,  $b^*$  values are measured from the viewing surface of the
- 20 topsheet inboard of the absorbent article's periphery. These  $L^*$ ,  $a^*$ ,  $b^*$  values are reported in terms of the CIE 1976 color coordinate standard. The color differences between the colored portion and the non-colored portion are measured at a first point, a second point, and a third point on the viewing surface of the topsheet inboard of the periphery of the absorbent article. Preferably, each one of the points noted (i.e., 1, 2 and 3) resides fully
- 25 within the periphery of the absorbent core. For example, the first point is measured within the first shade, the second point is measured within the second shade, and the third point is measured within the non-colored portion of the absorbent article. The color differences are calculated according to method ASTM D2244-99 "Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates."

The difference in color (i.e.,  $\Delta E^*$ ) between the first shade and the second shade should be at least 3.5. The  $\Delta E^*$  is calculated by the formula  $\Delta E^* = [(L^*_X - L^*_Y)^2 + (a^*_X - a^*_Y)^2 + (b^*_X - b^*_Y)^2]^{1/2}$ . X may represent points 1, 2 or 3. Y may represent points 1, 2 or 3. X and Y should never be the same two points of measurement at the same time. In other words,  $X \neq Y$ . The difference in color between the first shade and the non-colored portion is at least 6. The difference in color between the second shade and the non-colored portion is at least 3.5. Preferably, the size of the colored portion ranges from about 5% to about 100% of the viewing surface of the topsheet. Also preferably, the first shade of the colored portion is positioned substantially centrally in relation to the second shade of the colored portion. However, so long as the shades are in proper spatial relationship to one-another such that the depth perception phenomena is created, any suitable positioning of the shades is suitable and foreseeable by one of skill in the art and are therefore acknowledged as suitable alternative embodiments of the invention.

In one embodiment herein, the colored portion may be an insert positioned between the topsheet and the absorbent core. In another embodiment, the colored portion forms a part of the topsheet. In yet another embodiment herein, the colored portion forms a part of the absorbent core whereby the colored portion is viewable from the viewing surface of the topsheet. Alternatively, the colored portion may be a multi-layered insert positioned beneath the topsheet.

Any topsheet material that allows the colored portion to be readily seen from the viewing surface of the topsheet is suitable. For example, formed film material, nonwovens, other topsheet materials known in the art or combinations thereof are suitable.

In an alternative embodiment herein, the absorbent article provides a colored portion and is substantially without a non-colored portion. The colored portion is viewable from the viewing surface of the topsheet and has at least two shades, a first shade and a second shade. The first shade is positioned substantially within the second shade, the second shade being different from the first shade. The at least two shades

operate to create a perception of depth within the absorbent article by a user looking upon the viewing surface of the topsheet.

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### **BRIEF DESCRIPTION OF THE DRAWINGS**

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as forming the present invention, it is believed that the invention will be better understood from the following descriptions which are taken in conjunction with the accompanying drawings in which like  
10 designations are used to designate substantially identical elements, and in which:

FIG. 1 is a perspective drawing of the absorbent article;

FIG. 2 is a planar view of the absorbent article of FIG. 1;

FIG. 3 is a planar view of an alternative embodiment of FIG. 1; and

FIG. 4 is a planar view of the proper testing form of the absorbent article of FIG.

15 1.

### **DETAILED DESCRIPTION OF THE INVENTION**

“Absorbent articles” as referred to herein are primarily sanitary napkins, pantliners, or incontinence pads that are worn in the crotch region of an undergarment. It is even  
20 conceivable that baby diapers, adult incontinence diapers, and human waste management devices benefit from the present invention even though they are conventionally not worn in conjunction with an undergarment.

The term ‘color’ as referred to herein include any primary color, i.e., white, black, red, blue, violet, orange, yellow, green, and indigo as well as any declination thereof or  
25 mixture thereof. The term ‘non-color’ or ‘non-colored’ refers to the color white which is further defined as those colors having an L\* value of at least 90, an a\* value equal to  $0 \pm 2$ , and a b\* value equal to  $0 \pm 2$ .

The term ‘disposable’ is used herein to describe absorbent articles that are not intended to be launched or otherwise restored or reused as absorbent articles (i.e., they are

intended to be discarded after a single use and, preferably to be recycled, composted or otherwise disposed of in an environmentally compatible manner).

Non-limiting examples of panty liners and sanitary napkins which may be provided with a multi-tone signal that operates to create depth perception include those  
 5 manufactured by The Procter & Gamble Company of Cincinnati, Ohio as: ALWAYS® Pantliners with DriWeave® manufactured according to U.S. Patent Nos. 4,324,246; 4,463,045; and 6,004,893; ALWAYS® Ultrathin Slender Maxi with Wings manufactured according to U.S. Patent Nos. 4,342,314, 4,463,045, 4,556,146, B1 4,589,876, 4,687,478, 4,950,264, 5,009,653, 5,267,992, and Re. 32,649; ALWAYS® Regular Maxi; ALWAYS  
 10 ® Ultra Maxi with Wings; ALWAYS® Maxi with Wings; ALWAYS® Ultra Long Maxi with Wings; ALWAYS® Long Super Maxi with Wings; and ALWAYS® Overnight Maxi with Wings, each aforesaid publication being incorporated by reference herein.

FIG. 1 provides a perspective view of the absorbent article 10. FIG. 2 provides a planar view of the absorbent article of FIG. 1. The absorbent article 10 herein has an  
 15 upper surface 13, a lower surface 14 (not seen) and a periphery 12 comprising a topsheet 25 having a bottom surface 27 (not shown) and a viewing surface 28 positioned opposite to the bottom surface 27. The viewing surface 28 faces upwardly towards the upper surface 13 of the absorbent article 10. The absorbent article 10 further comprises a backsheet 15 (not shown) having a garment facing surface 16 (not shown) and a user  
 20 facing surface 17 (not shown) positioned oppositely to the garment facing surface 16, the backsheet 15 being joined to the topsheet 25.

The absorbent article 10 also comprises an absorbent core 20 having a top surface 21 and a bottom surface 22 (not shown) that is positioned opposite to the top surface 21. The absorbent core 20 is positioned between the topsheet 25 and the backsheet 15. In the  
 25 embodiment shown in FIG. 1 the absorbent article 10 has at least two portions, i.e., a colored portion 40 and a non-colored portion 50. The colored portion 40 and the non-colored portion 50 are viewable from the viewing surface 28 of the topsheet 25. The colored portion 40 has at least two shades, a first shade 42 and a second shade 44. Preferably, but not necessarily, and as is shown in FIG. 1, the first shade 42 is positioned

substantially within the second shade 44. The second shade 44 is different, either in lightness, darkness, and/or color, from the first shade 42. The multi- shades operate to create a perception of depth within the absorbent article by a user looking upon the viewing surface 28 of the topsheet 25. In one embodiment herein, the first shade 42 of the color is darker than the second shade 44 of the color. Alternatively, the first shade 42 is lighter than the second shade 44. The lightness and darkness of the shades, whether two or greater than two shades, are configured to create a perception of depth by a user looking upon the viewing surface 28 of the absorbent article 10.

The color of the first shade 42 and the second shade 44 of the colored portion 40 and the non-colored portion 50 are measured by the reflectance spectrophotometer according to the colors'  $L^*$ ,  $a^*$ , and  $b^*$  values. The  $L^*$ ,  $a^*$ , and  $b^*$  values are measured from the viewing surface 28 of the topsheet 25 inboard of the absorbent article's periphery 12. The color differences between the colored portion 40 and the non-colored portion 50 are measured at a first point 100, a second point 110, and a third point 120 on the viewing surface 28 of the topsheet 25 inboard of the periphery 12 of the absorbent article 10. Preferably, each one of the points 100, 110, and 120 resides fully within the periphery 12 of the absorbent core 20. For example, the first point 100 is measured within the first shade 42, the second point 110 is measured within the second shade 44, and the third point 120 is measured within the non-colored portion 50 of the absorbent article 10.

The color differences are calculated using the  $L^*$ ,  $a^*$ , and  $b^*$  values by the formula  $\Delta E = [(L^*_x - L^*_y)^2 + (a^*_x - a^*_y)^2 + (b^*_x - b^*_y)^2]^{1/2}$ . Herein, the 'X' in the equation may represent points 1, 2 or 3. Y may represent points 1, 2 or 3. X and Y should never be the same two points of measurement at the same time. In other words,  $X \neq Y$ . Where greater than two shades of a color(s) are used, the 'X' and 'Y' values alternately include points of measurement in them also. The key to the  $\Delta E$  calculation herein is that the 'X' and 'Y' values should not stem from the same measured point on the viewing surface. In those instances where there is effectively no non-colored portion 50 within the confines of the

measurement area, the 'X' values should flow from a point different in spatial relationship to the 'Y' values, but within the confines of the absorbent core periphery (see FIG. 4).

The difference in color ( $\Delta E^*$ ) between the first shade 42 and the second shade 44 should be at least 3.5. The difference in color between the first shade 42 and the non-colored portion 50 is at least 6. The difference in color between the second shade 44 and the non-colored portion 50 is at least 3.5.

5 ~~50%~~ Preferably, the size of the colored portion 50 ranges from about 5% to about 100% of the viewing surface 28 of the topsheet 25. Also preferably, the first shade 42 of the colored portion 50 is positioned substantially centrally in relation to the second shade 44 of the colored portion 50. However, so long as the shades are in proper spatial relationship to one-another such that the depth perception phenomena is created, any suitable positioning of the shades is foreseeable by one of skill in the art and are therefore acknowledged as suitable alternative embodiments of the invention.

10 In one embodiment herein, the colored portion 40 may be an insert positioned between the topsheet 25 and the absorbent core 20. In another embodiment, the colored portion 40 forms a part of the topsheet 25. In yet another embodiment herein, the colored portion 40 forms a part of the absorbent core 20 whereby the colored portion 40 is viewable from the viewing surface 28 of the topsheet 25. Alternatively, the colored portion 40 may be a multi-layered insert positioned beneath the topsheet 28.

20 Any topsheet material that allows the colored portion to be readily seen from the viewing surface 28 of the topsheet 25 is suitable. For example, formed film material, nonwovens, or combinations thereof are suitable.

25 In an alternative embodiment herein, the absorbent article 10 provides a colored portion 40 wherein the viewing surface 28 of the topsheet 25 is substantially without a non-colored portion. By the term 'substantially without a non-colored portion' it is meant herein that color white is less than or equal to 5% of the total surface area of the viewing surface 28. FIG. 3 provides an absorbent article wherein the first shade 42 is lighter and the second shade 44 is darker.



Also alternatively is an embodiment in which a color different from the color of the first shade 42 and the second shade 44 operates as a boundary between the two shades. In other words, this boundary 48 (not shown) rings the outer perimeter of the second shade 44 and separates the second shade 44 from the first shade 42.

5

#### **Analytical Methodology--Hunter Color**

The color scale values, utilized herein to define the darkness/lightness of the materials of the absorbent articles according to the present invention, is the widely accepted CIE LAB scale. Measurements are made with a Hunter Color reflectance meter.

10 A complete technical description of the system can be found in an article by R.S. Hunter, 'photoelectric color difference Meter', Journal of the Optical Society of America, Vol. 48, pp.985-95, 1958. Devices specially designed for the measurement of color on the Hunter scales are described in U.S. Patent No. 3,003,388 to Hunter et al., issued October 10, 1961. In general, Hunter Color "L" scale values are units of light reflectance

15 measurement, and the higher the value is, the lighter the color is since a lighter colored material reflects more light. In particular, in the Hunter Color system the "L" scale contains 100 equal units of division. Absolute black is at the bottom of the scale (L=0) and absolute white is at the top of the scale (L=100). Thus in measuring Hunter Color values of the materials used in the absorbent articles according to the present invention,

20 the lower the "L" scale value, the darker the material. The absorbent articles herein, and hence the materials of which the absorbent articles are made of, might be of any color provided that the L Hunter value defined herein is met.

Colors can be measured according to an internationally recognized 3D solid diagram of colors where all colors that are perceived by the human eye are converted into

25 a numerical code. The CIE LAB system is similar to Hunter L, a, b an is based on three dimensions, specifically L\*, a\*, and b\*.

When a color is defined according to this system L\* represents lightness (0 = black, 100 = white), a\* and b\* independently each represent a two color axis, a\* representing the

axis red/green (+a = red, -a = green), while b\* represents the axis yellow/blue (+b = yellow, -b = blue). FIG. 4 shows the proper representation of the L, a, and b axes.

A color may be identified by a unique  $\Delta E$  value (i.e., different in color from some standard or reference), which is mathematically expressed by the equation:

5

$$\Delta E^* = [(L^*_x - L^*_y)^2 + (a^*_x - a^*_y)^2 + (b^*_x - b^*_y)^2]^{1/2}$$

'X' represents the standard or reference sample which may either be a 'white' sample or a 'colored' sample, e.g., one colored shade may be compared to another colored shade.

10 It is to be understood that the tristimulus color values and  $\Delta E^*$  considered herein are those measured on the materials of interest (e.g., the colored and non-colored portions on the viewing surface of the topsheet disclosed herein).

The Hunter color meter quantitatively determines the amount (percent) of incident light reflected from a sample onto a detector. The instrument is also capable of analyzing  
15 the spectral content of the reflected light (e.g., how much green is in the samples). The Hunter color meter is configured to yield 3 values ( $L^*$ ,  $a^*$ ,  $b^*$  and  $\Delta E^*$  which is total color). The  $L^*$  value is simple the percent of the incident (source) light that is reflected off a target sample and onto the detector. A shiny white sample will yield an  $L^*$  value near 100 while a dull black sample will yield an  $L^*$  value of about 0. The  $a^*$  and  $b^*$  value  
20 contains spectral information for the sample. Positive  $a^*$  value indicates the amount of green in the sample.

Testing is conducted using a Lab Scan XE 45/0 geometry instrument to measure the different shaded options for the visual signal zone. The Hunter Color in CIE lab scale  
25  $2^\circ$  C was measured on each pad in 3 portions. A 0.7 inch diameter port was used having a 0.50 inch area view, which was the largest size able to measure each zone discretely; i.e., this 0.5 inch area view is important for the purposes these measurements and should not be made smaller than the 0.5 inch area view prescribed. The instrument was calibrated using standard white and black tiles supplied by the instrument manufacturer.

### **Color Zone Measurement for Pad Topsheet Appearance**

For measuring the  $L^*$ ,  $a^*$ , and  $b^*$  values for the invention herein, a standard, industry-recognized procedure is used. The topsheet color is measured using a reflectance spectrophotometer in accordance with method ASTM E 1164-94, "Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation". This standard method is followed but specific instrument settings and sampling procedure are given here for clarity. Sample color is reported in terms of the CIE 1976 color coordinate standard as specified in ASTM E 1164-94 and ASTM D2264-93, section 6.2. This consists of three values;  $L^*$  which measures sample "lightness",  $a^*$  which measures redness or greenness, and  $b^*$  which measures yellowness or blueness.

### **Apparatus**

Reflectance Spectrophotometer .....45°/0°Hunter Labscan XE, or equivalent  
 HunterLab Headquarters, 11491 Sunset Hills  
 Road, Reston VA 20190-5280 Tel: 703-471-  
 6870 Fax: 703-471-4237  
<http://www.hunterlab.com>.  
 Standard plate .....Standard Hunter White Tile Source: Hunter  
 Color.

### **Equipment Preparation**

1. Assure that the Spectrophotometer is configured as follows:
  - Illumination .....Type C
  - Standard Observer....2°
  - Geometry .....45/0° Measurement angle
  - Port Diameter.....0.70 inch
  - Viewing area.....0.50 inch (and no smaller)
  - UV Filter: Nominal
2. Calibrate the spectrophotometer using standard black and white tiles supplied with the instrument according to manufacturer's instructions before beginning any testing.

### **Sample Preparation**

1. Unwrap, unfolded and lay the product or pad samples flat without touching or altering the color of the body facing surface.
2. Areas on the body-facing surface of the product should be selected for measurement and must include the following:
  - The non-colored portion of the topsheet.

- The colored portion of the topsheet; including the two or more shaded portions.
  - Any other portions of the topsheet above the absorbent core having a visibly or measurably different color from the first shaded zone.
- 5 Embossed channels and folds should not be included in zones of measurement as they may skew the proper results. Measurements should not be made overlapping the border of two shaded portions.

### **Test Procedure**

- 10 1. Operate the Hunter Colorimeter according to the instrument manufacturer's instructions.
2. Pads should be measured laying flat over the 0.70 inch aperture on the instrument. A white tile should be placed behind the pad.
- 15 3. The pad should be placed with its long direction perpendicular to the instrument.
4. Measure the same zones selected above for at least 3 replicate samples.

### **Calculation Reporting**

1. Ensure that the reported results are really CIE  $L^*, a^*, b^*$ .
- 20 2. Record the  $L^*, a^*, b^*$  values to the nearest 0.1 units.
3. Take the average  $L^*, a^*, b^*$  for each zone measured.
4. Calculate  $\Delta E^*$  between different shaded portions and  $\Delta E^*$  between each shaded portion and the non-colored portion where the non-colored portion exists.

25

### **Human Sensitivity to Light**

The human sensitivity threshold for the lightness of a dark green color is a  $\Delta E^*$  of about 1.0. For a dark green color, if only the  $a^*$  and  $b^*$  change, human sensitivity is a  $\Delta E^*$  of 2.4. In the context of an absorbent article herein (e.g., a sanitary napkin) it is

30 highly likely that many people would not see a color difference if the  $\Delta E^*$  is less than 2. This sensitivity is described in the following reference: "The Measurement of Appearance", by Hunter and Harold, 2nd edition, 1987, (ISBN 0-471-83006-2).

Chapter 4 of Hunter's book describes human color sensing and chapter 9 is about color scales. By making side-by side comparison, humans can differentiate up to 5 to 10

35 million different colors. In the 1940s, a researcher named MacAdam did human chromaticity discrimination experiments. He found the thresholds of sensitivity and

showed these depend on the color. Later work by Brown and MacAdam came up with a logarithmic lightness dimension scale for human sensitivity to go with the earlier color scale. Based on the reduction to practice of the invention, experimentation and the foregoing work by Brown and MacAdam, it has been found herein that a  $\Delta E \geq 3.5$  is the preferred range to effect proper differentiation between the shades that provides the proper appearance of depth. However, where the  $\Delta E$  is as small as about 1 and still operates to provide a perception of depth between the shades, this  $\Delta E$  is also contemplated and included herein. An example where  $\Delta E$  may be between at last two shades of one or more colors may be found in an alternative embodiment that provides a multi-color and/or shade gradient of a color across the viewing surface of the absorbent article.

**CHART I**

Sample Number	Topsheet Type	Colored Options	$\Delta E^*_{23}$	$\Delta E^*_{12}$	$\Delta E^*_{13}$
1	Formed Film	Two-tone inner/outer color	6.10	10.83	16.86
2	Formed Film	One-tone color	0.25	8.60	8.80
3	Non-woven	One-tone color	0.22	10.63	10.81
4	Non-woven	Two-tone inner/outer color	5.98	11.03	16.92
5	Formed Film	Two-tone light outer color / inner dark color	10.01	2.88	12.80
6	Formed Film	Two-tone medium outer color /inner dark color	7.51	6.37	13.61
7	Formed Film	Two-tone darker outer color /inner dark color	5.60	19.16	14.22
8	Formed Film	Two-tone (secondary topsheet colored outer color) / (core colored dark color)	4.58	6.00	8.06

9	Formed Film	One-tone outer color	0.21	8.90	8.84
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As has been noted previously, the difference in color between the first shade and the second shade should be at least 3.5. The difference in color between the first shade and the non-colored portion is at least 6. The difference in color between the second shade and the non-colored portion is at least 3.5. Through experimentation and reduction to practice of the invention, it has been determined that the preferred creation of depth perception happens at about and above these set parameters. For products substantially not having a non-colored portion within the measurement zone (i.e., a gradient or fully colored product), the above criteria for the shaded portions (i.e.,  $\Delta E^* \geq 3.5$ ) remains the preferred standard.

Chart I above clearly shows the  $\Delta E^*$ s obtained between multi-tone (e.g., two tone) and single tone signals. Formed films and nonwovens useful for the invention herein are those which will allow the sufficient penetration of light therethrough such that the shaded portions may be clearly discerned and such that such discernment produces the depth perception effect. The color may be any suitable color fitting within the parameters herein for  $\Delta E^*$  between colored portions and non-colored portion (where it exists). For example, the colors green, blue, red, yellow, orange, purple and any other color within the color spectrum are suitable for the purposes described herein.

Sample Nos. 1 and 2 are clearly distinct in their  $\Delta E^*_{23}$ . Specifically, the  $\Delta E^*_{23}$  (which is 6.10) is greater than 3.5. This  $\Delta E^*_{23}$  indicates that there is a perceptible difference in color or lightness/darkness between the two points of measurement; i.e., between the second shaded portion and the non-colored (or white) portion (see FIG. 4). As noted above for human perception, Sample No. 2's  $\Delta E^*_{23}$  of 0.25 would not be perceptible to the human eye. This indicates that the signal is only a one or single tone signal (i.e., color portion).

The disclosures of all patents, patent applications (and any patents which issue thereon, as well as any corresponding published foreign patent applications), and